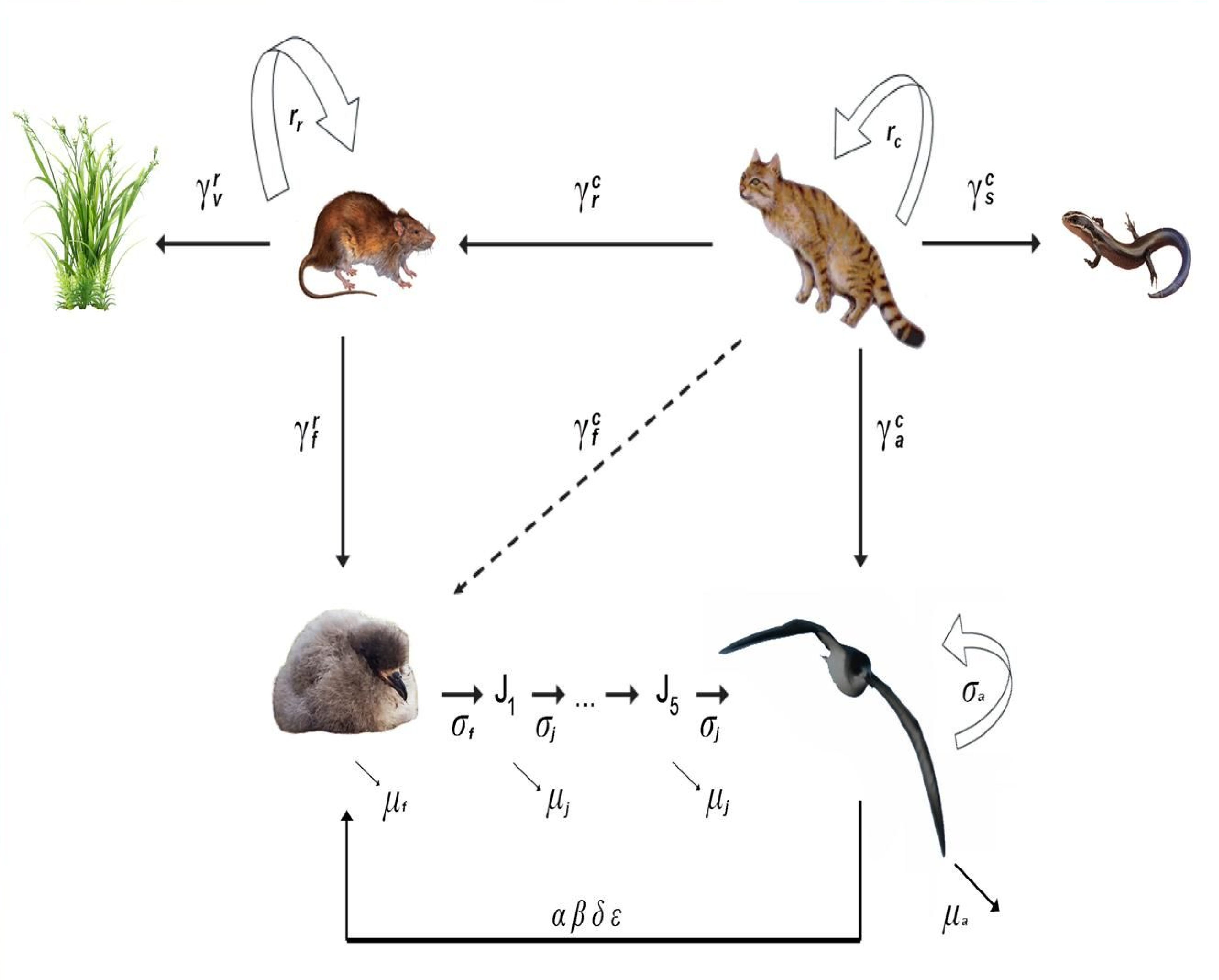
Mesopredator Release Effect on Long-Lived Prey

James Russell, Vincent Lecomte, Yves Dumont, Matthieu Le Corre (matthieu.lecorre@univ-reunion.fr)

Université de la Réunion, 15 avenue René Cassin, Saint Denis, France

SUMMARY

"Mesopredator release effect" has been hypothesised as a possible indirect effect from eradications, where superpredator (e.g. 'cat') removal can generate a mesopredator (e.g. 'rat') increase which may increase the impact on their shared prey (e.g. 'birds'). Using more biologically realistic models for seabirds and introduced mammalian predators we show that mesopredator release only occurs in strongly top-down moderated (resource-abundant) systems. Even when mesopredator release can occur, the negative impact of more mesopredators is outweighed by the benefit of superpredator removal, allowing recovery of the prey population. The consideration of age-structured prey contradicts previous theoretical results for mesopredator release effect. Only superpredator eradication (not control) allows the population recovery of long-lived insular species.



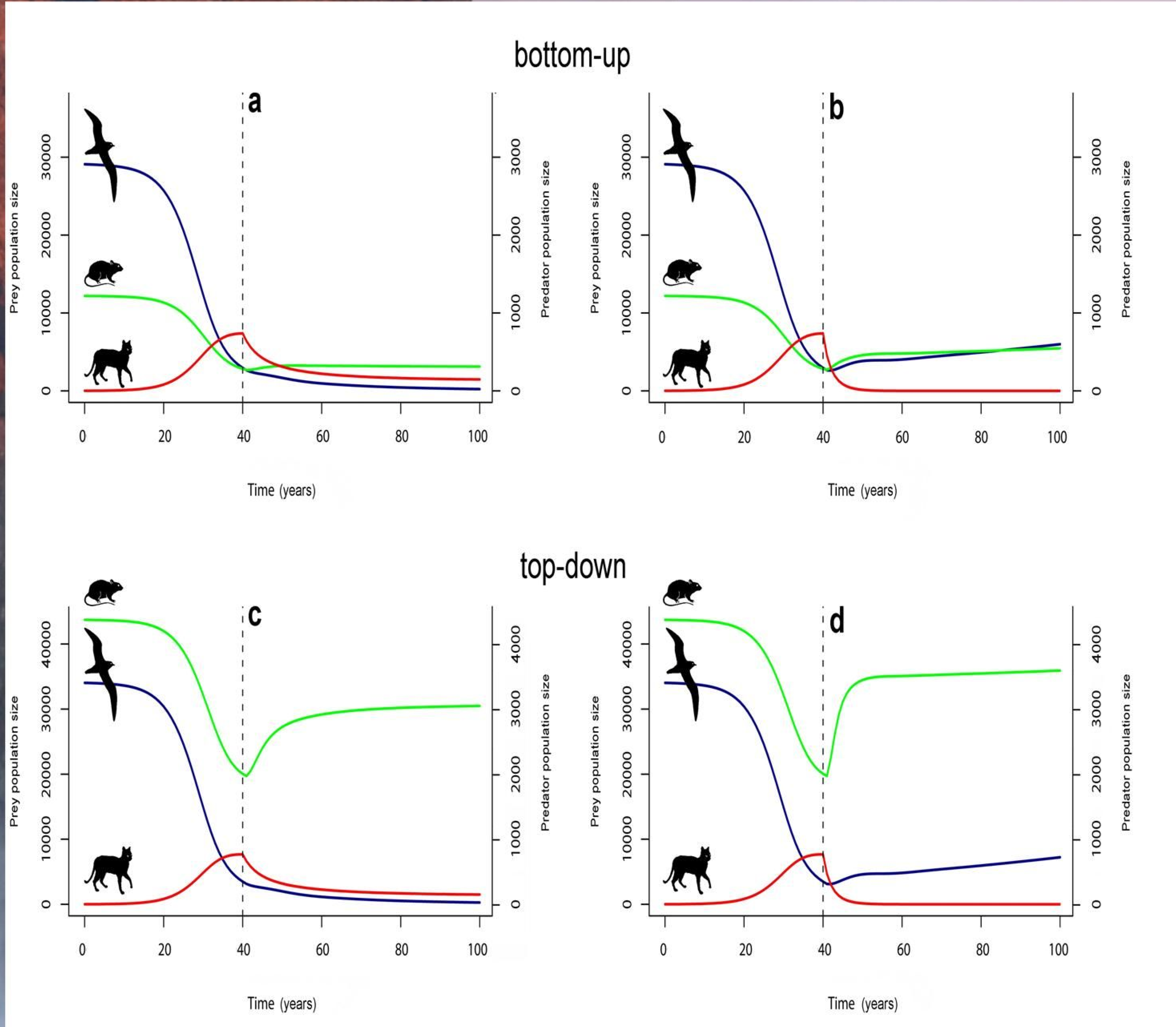
Conceptual model used in this study showing age-structure of the native prey and differential predation of both meso- and super-predators

BACKGROUND

Previous theoretical mathematical models have demonstrated a 'mesopredator release effect' suggesting that for introduced predators, the superpredator may protect the shared prey from mesopredation, and removal of superpredators alone is not recommended. These models, however, did not use biologically realistic data for island ecosystems, and assumed equilibrium dynamics. Furthermore, mesopredator release effect of introduced predators has never been convincingly demonstrated at the population level on an island.

MODEL

We model an intraguild predator age-structured prey system using coupled logistic differential equations. The superpredator can impact all prey life-stages (adult survival and reproductive success) whereas the smaller mesopredator can only impact early life-stages (reproductive success). Prey have a sub-adult phase of 5 years 'at sea'. This model is independently tested with field data from Barau's petrel (*Pterodroma baraui*) on Réunion Island. We explore the non-equilibrium dynamics of the system, including predator control, and the effect of 'top-down' (resource abundant) versus 'bottom-up' (resource limited) regulation. Results were robust to 10% variation in model parameters.



Simulations of non-equilibrium dynamics over time with predator control. Seabird (prey) and rat (mesopredator) populations start at equilibrium prior to the introduction of a single pregnant female cat. Cat control then occurs at time t = 40 years. (a) Bottom-up (food limited) system, with 20% annual cat control; (b) bottom-up (food limited) system, with 80% annual cat control (effectively a 5-year eradication program); (c) top-down (predator mediated) system, with 20% annual cat control; (d) top-down (predator mediated) system, with 80% annual cat control (effectively a 5-year eradication program). Dotted line indicates cat control initiated. Seabird and rat populations start at equilibrium prior to introduction of a single pregnant female cat.

Russell, J. C.; Lecomte, V.; Dumont, Y.; Le Corre, M. (2009) Ecological Modelling, 220 (8), 1098-1104.

This work was supported by the French National Research Agency (ANR-05-BDIV-003-03) and the French Ministry of Ecology and the Environment.